



Maple BMIPs



A Handbook for the
Massachusetts
Maple Industry



UMassAmherst Outreach UMass
Extension



Maple Syrup BMPs

A Handbook of Best Management Practices for Massachusetts Maple Syrup Farms

This handbook is a cooperative publication of the Massachusetts Farm Bureau Federation, University of Massachusetts Extension, and the Massachusetts Department of Agricultural Resources.

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Massachusetts Maple Syrup Best Management Practices (BMP) Guidelines



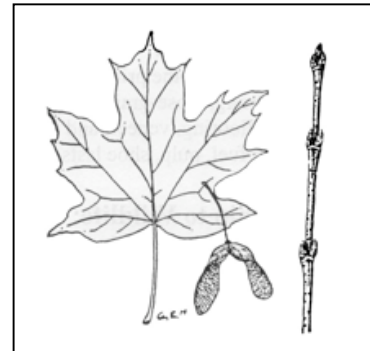
INTRODUCTION

Historical Maple Syrup Production

It can be argued that maple syrup is one of the original “natural foods” to originate in the New World. Although the identity of the first sugar maker is lost to time, the production of this sweet confection is traditionally first ascribed to indigenous inhabitants of North America. In turn, European colonists and settlers struggling to eke out subsistence from the land learned about the special properties of sap from the sugar maple (*Acer saccharum*).

Earliest collection and processing of sap was primitive, involving collection of sap in wooden or bark containers placed so as to catch sap dripping from wounds made to the tree trunk. Later, crude wooden spouts made from hollow sumac or elder stems were driven into holes drilled into the tree to more effectively catch the valuable sap. Further efficiency of collection resulted from the use of wooden buckets hung from the trees.

Evaporation of water was accomplished by heating clay or metal vessels over an open fire or by placing hot stones into hollowed-out wooden logs holding the raw sap. As sap evaporated, more was added and the process continued until the syrup was deemed to be “finished”. As one would expect, the quality of the “maple syrup” produced was a far cry from that produced in today’s modern sugarhouses.



*From Univ. of Maine Coop Extension
Maine Tree Species Fact Sheet Series
www.extension.umaine.edu/mainetreecclub*

Possible Contaminants in Maple Syrup

Early maple syrup would undoubtedly have been extremely dark in color and would likely have been contaminated with grit or ash from the evaporation process. Fortunately, modern sap and syrup filtration methods result in a very low possibility of physical contamination from grit and ash, dust, wood chips, glass metal or plastic.

Unlike the situation with some dairy and meat products, or fresh fruits and vegetables, harmful bacteria (e.g., *E. coli*, *Salmonella*, *Listeria*, etc.) are

unable to survive in maple syrup due to its high sugar content. However, yeasts and molds can colonize syrup if it is inadequately “finished” or if proper care is not directed to packaging the product into containers. Most sources suggest that microbial contamination of maple sap and syrup represents more of a quality issue than a food safety issue. Nonetheless, as we will discuss subsequently there is a relationship between microbes in sap and possible chemical contamination.

Ironically, technological enhancements in the 1800s resulting from invention of flat pan and then continuous-flow evaporators as well as metal gathering and storage containers, raised the prospects of chemical contamination from metals such as lead (from lead solder) or zinc (from “tern plate” also used to make the equipment). Add to this the possibility of contamination from excessive use of cleaning solutions (e.g., chlorine), chemical de-foaming agents, improperly manufactured sap tubing or petroleum residues from retail metal containers, and producers are well advised to be constantly vigilant in protecting the quality of pure maple syrup.

With this background in mind, the purpose of this guide is to help commercial producers identify possible enhancements to their sugaring operations that maintain high standards of cleanliness in all phases of the process, reduce to the lowest extent possible the potential for contamination of the finished product, and achieve the highest possible quality pure maple syrup.



GENERAL OPERATIONS

Sugarbush Management

Site Selection and General Management

The ideal maple sugar-bush consists of a stand of healthy, mixed aged sugar maple (perhaps with some Red maple, *A. rubrum*, mixed in) growing on a well drained, but not droughty site with good soils. A limited presence of other tree species such as American Beech, white ash, red oak, hemlock and others is both natural and desirable as the diversity they represent fosters wildlife habitat and timber production. The ideal tree has a large, well-developed crown such as might be found along a roadside or tree line, as these often produce the sweetest sap. Tree density is best if all crowns have adequate space to grow into such that they can capture the greatest possible amount of solar insolation while still allowing regenerative growth of seedlings and young maples in the under story. Periodic removal of damaged, diseased or insect infested trees as well as those that are lower quality or poorer producing is desirable on an ongoing basis. Removal of

such trees allows younger trees to develop fuller crowns and grow more rapidly.

When developing a new sugar-bush, care should be taken to identify properly and clean up any possible sources of toxic waste or pollution in or adjacent to the site. Access roads should be located to reduce the possibility of mechanical damage to maple roots and to reduce mud or dust as contaminants of sap, especially when buckets are the primary sap collection method.

Livestock pasturage is not a problem unless overgrazing results in damage to trees or elimination of regenerative maple growth. Although synthetic fertilizers and pesticides are rarely if ever applied to sugar maple stands, their use should be under guidance of a forestry professional and in full compliance with the label.

Safety in the Sugaring Operation

By its very nature, farming of any sort can be hazardous, given the almost daily use of tractors, chainsaws and other machinery, the need to lift and otherwise manipulate heavy objects, the potential for falls, and frequent exposure to mechanical/electrical systems, chemicals and the elements. To minimize risks, maple producers should periodically inventory their operations to identify potential sources of hazard, develop a safety plan to reduce risks, and train staff in safe operational procedures.

Natural hazards such as dead, hanging limbs and branches are a common hazard in the sugarbush, especially under windy conditions. Even a relatively small branch can be deadly when falling from great height, so working in the woods should be avoided when it is windy.

When using a chainsaw, always follow proper procedures, including never working alone, wearing a eye and hearing protection, safety helmet, “hard” footwear, chaps, and other personal protective equipment (PPE), and keeping chains properly sharpened.

Power tapping machines also have potential to cause hearing injury, so always use protection when tapping. Make sure that tappers are idling properly so that the bit stops spinning when the throttle is released. Avoid wearing loose clothing as spinning bits can catch on clothing and cause injury in a matter of seconds when moving around trees.

Under cold conditions, always dress properly and be aware of the conditions that can cause hypothermia (low body temperature) and frostbite. Familiarize your self with the symptoms of cold injuries and with appropriate first aid techniques (refer to pages 269-271 in the *North American Maple Syrup Producer’s Manual* for an excellent coverage of this topic).

When snow or ground conditions are icy (e.g., after a freezing rain event or when working on icy, frozen snow), use of crampons or similar ice-gripping equipment is recommended, particularly when using a chainsaw or power tapper.

Sugarhouse Design and Construction

Ideally, commercial sugarhouses should be constructed so as to exclude birds, rodents, insects, and other pests, each of which can cause contamination of the finished product. Interior surfaces should be of impermeable materials that can be periodically cleaned as needed to eliminate microbial growth. A potable water source that is periodically tested for continued potability is essential due to the need for water in cleaning equipment and for maintaining personal hygiene. At minimum, a hand washing station should be provided for staff and visitors.

All sugarhouse equipment that comes in contact with syrup should be designed for the safe production of maple syrup and ideally should be lead free stainless steel. All equipment and working surfaces should be periodically cleaned and sterilized if they become contaminated. Materials such as pesticides, other toxic chemicals or fuels should not be stored in or used in the sugarhouse itself. Use only food grade lubricants for any equipment (e.g., gear pumps) used in gathering or handling sap or syrup.

Sugarhouse Water

A sugarhouse must have a source of clean potable (drinkable) water. Wells, whether drilled or dug, should be periodically tested by a capable laboratory to ensure that water used is free of microbial, physical or chemical contamination. Water should be tested at least once per year for presence of *E. coli* and coliform bacteria and only used if it meets standards for safe drinking water.

When possible, a properly installed sink with hot and cold water faucets should be available for hand-washing and cleaning small pieces of equipment.

Sugarhouse Safety

Hazards that can be encountered in sugarhouses include electrical shock, burns, fires, falls and exposure to corrosive chemicals.

To minimize risk from electrical shock, all sugarhouse service and equipment should be installed by a properly licensed electrician and be properly grounded. All electric circuits should be protected by ground fault circuit interrupters (GFCI) whenever moisture is likely to be present.

Sugaring workers should be aware of the many hot surfaces in a sugaring operation (e.g., evaporator arch, pans, steam hoods, pre-heaters, oil burners, draw off valves, stack, etc.). When firing with wood or otherwise operating the evaporator, always wear long-sleeved garments and firing gloves. Keep visitors to the sugarhouse as far as possible from hot surfaces and out of the way of persons firing or running the evaporator.

Under certain conditions, entire sugarhouses have been lost due to fire. Given the fact that many sugaring operations are situated in rural or

even remote locations, one or more, properly-charged, large capacity (10 pound) ABC type dry chemical fire extinguisher should be available as needed.

Pre-Season Sugarhouse Preparation

Wash all equipment with clean potable water to remove any dust dirt or other foreign substances. Clean and rinse RO machines according to manufacturer's recommendations. Flush the pre-heater with potable water before using. Fill the evaporator with clean water and boil for an hour prior to use: rinse thoroughly. Wash and air dry sap filters prior to re-use.



SAP COLLECTION

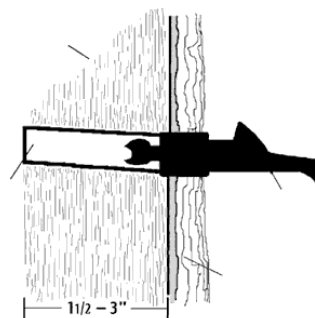
Tapping

The process of annual tapping of maple trees is a critical step in producing high quality sap and syrup. Careful placement of new tap holes to avoid decayed patches in tree trunks is essential in order to maximize sap flow and reduce the potential for "off" flavors in sap and the resulting syrup. New tap holes should be no closer than 5" to either side or 6" above or below old holes.

Drill only into new (white) wood using sharp bits that cut a neat, clean hole. Bit size will vary depending on whether one is using 7/16 or 5/16 diameter (or smaller) spouts. Regardless of diameter, tap holes need be no deeper than 1 1/2 to 2 inches to ensure adequate flow. Sanitize bits at the beginning of tapping and after any subsequent contact with decayed wood or the ground by washing them in a detergent solution and then soaking them in alcohol or a solution of 1 oz. household bleach to 1 pt. water followed by a thorough rinsing with clean water. Avoid blowing into or inserting a twig into tap holes to clear wood chips as this can result in contamination of the hole: use only a clean, sterilized tool.

Whenever possible, tapping should be delayed until trees are partially or completely thawed and immediately before the sap flow is anticipated since drilling into frozen trees can often cause cambial dieback and bark cracking around the tap hole.

Attempting to sanitize tap holes with bleach or alcohol is not recommended and paraformaldehyde pellets may not legally be used in the U.S. or Canada.



*From Ohio State Univ. Fact Sheet
Series; F-36-02, Maple Syrup
Production*

Spout types

Many different types of spouts are available to the producer, including metal spouts suitable for hanging buckets, plastic spouts of various sizes for use with tubing systems, and, most recently, stainless steel spouts. While 7/16 diameter spouts have been the norm for many years, recent research has shown that smaller spouts (5/16" or 19/64") can result in about the same sap yield especially in vacuum systems. These smaller tap holes close more quickly, remove less wood from the tree, and result in less internal "staining" of the sapwood, so are now considered more desirable to use in terms of maintaining tree health.

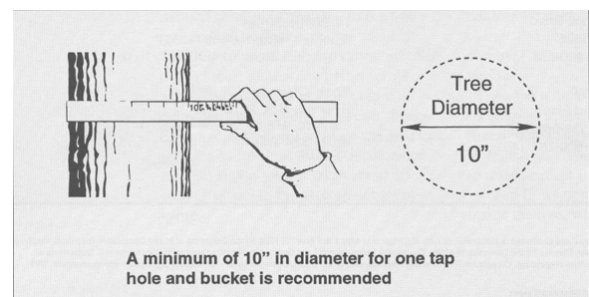
As noted earlier, sanitizing spouts and drill bits prior to use is important to reduce microbial growth in tap holes. For this reason, particularly in tubing systems that are left out year round, some producers now use separate, removable inserts that are driven into tap holes and into which spouts or "stubbies" are inserted.

A new design spout that serves as a check valve (to prevent sap from flowing back into tap holes under negative pressure or when vacuum is shut down) has recently been introduced. University of Vermont research has indicated that improved sap yield is possible over the season using this new design, particularly under certain environmental conditions. Producers may want to experiment with such new designs until they have been evaluated in the field to a larger extent than at present.

Irrespective of which types of spouts producers employ, the least possible force should be used in setting spouts in order to avoid cracking the tap hole. A wooden or plastic mallet rather than a hammer should be adequate for proper seating. Cracking, in addition to allowing sap and vacuum leakage, is an opportunity for microbial contamination of the tap hole to occur in tubing systems.

Tapping guidelines

Over time, published tapping guidelines have tended to become more conservative in order to protect tree health. Although there is no generally agreed upon standard most sources suggest avoiding tapping trees less than 10-12 inches (depending on spout size) in diameter and no more than 4 taps on trees greater than 24 inches in diameter. Reducing tapping density or suspending tapping entirely is recommended for trees that are stressed by factors such as drought, defoliation caused by insects or disease, ice damage or presence of



From Univ. of Maine Coop. Extension Fact Sheets; "How to Tap Maple Trees".

significant trunk damage. Stressed trees often show slow tap hole closure, branch dieback, and/or smaller or fewer than normal leaves.



SAP COLLECTION SYSTEMS

Buckets

Buckets made of various materials have long been a mainstay of sap collection systems, especially for widely scattered or roadside trees or sites that do not lend themselves to use of tubing systems. However, just as old, wooden buckets gave way to 16 quart galvanized ones, these in turn are being supplanted by aluminum buckets or plastic bags. Many older buckets contain lead in soldered joints or in the galvanized coating and this metal can leach into the sap, especially if the buckets are left un-emptied for a day or more.

The North American Maple Syrup Producers Manual (p. 91) notes unequivocally that: "old terneplate or tin buckets...should not be used for sap collecting". That source goes on to caution that: "under no circumstances should a container that has ever held a hazardous material", is "capable of rusting", has "thin galvanized coatings" or is "non-food grade plastic" be used to collect or store sap.

Buckets, gathering pails and collecting tanks should be cleaned immediately after the end of the season using with steam or detergent. If detergents are used, buckets should be carefully triple-rinsed to remove any residue and thoroughly dried before putting them away for the year. Prior to the next season, washing buckets with hot water and a mild (5-10%) bleach solution is recommended followed by triple rinsing with potable water.

Tubing systems

Although production of high-quality sap is certainly possible using buckets or bags, the "state-of-the-industry" standard must now be considered to be properly laid-out, tubing systems aided by mechanical vacuum. Such systems, in addition to being less labor-intensive, and thus more potentially profitable given the difficulty of securing adequate labor, can often make accessible otherwise difficult to reach sugar bushes, can reduce soil compaction and tree damage caused by machinery operation and can often result in improved sap yields, especially under otherwise marginal weather conditions.

Conversely, tubing systems, especially if left our year round need to be designed and maintained properly so that sap does not sit in the tubing for long periods, especially under warm, sunny conditions. In addition, prompt, proper cleaning with either water or mild bleach solutions at the end of the season, and even sometimes during the season, is critical to prevent

growth of a microbial "biofilm" on interior tubing surfaces. Any such growth can seriously impact sap quality, and lower quality sap will result in lower quality syrup.

In-place, end of season tubing cleaning can be done using commercially-available tubing washing machines that mix air and high pressure water (or solutions of water and sodium hypochlorite or water and food grade hydrogen peroxide) and force this through the tubing. Use of sodium hypochlorite solutions, while effective, requires thorough rinsing to remove residues, and can result in excessive squirrel damage to tubing and fittings. Food grade hydrogen peroxide is preferable since it leaves no residue and does not attract squirrels.

Regardless of what materials are used, removal of spouts and tubing cleaning should be completed immediately after the end of the season to reduce microbial buildup inside tubing and to enhance taphole closure.

For a more detailed discussion of techniques for washing tubing, refer to Chapter 6 in the *North American Maple Syrup Producers Manual*.



SAP STORAGE AND HANDLING

Sap Storage Tanks and Filters

As noted earlier, sap should not be collected or stored in tanks that were not intended for food uses or have other characteristics that might result in contamination by lead or other hazardous substances.

Filtering sap frequently will help maintain quality. Most common is use of paper or cloth filters to remove larger foreign material from the sap, but some producers also employ small pore (5 μ) cartridge filters or food-grade diatomaceous earth filters to reduce microbial content of sap. Whatever filter types are used, they should be cleaned, sanitized and rinsed frequently throughout the season to avoid bacterial contamination of fresh sap.

Cleaning storage tanks with hot water between runs will also help maintain cleanliness. If chlorine bleach solutions are used, any equipment so treated should be triple rinsed to remove any residue before fresh sap is collected or stored.

Sap storage tanks should be located outside the sugarhouse on the north or northwest side and out of direct sunlight. Refrigerating sap using stainless steel dairy bulk tank and plate coolers as well as use of commercial-scale UV sterilization systems can significantly reduce microbial growth in maple sap and maintain its quality over time. Several types of UV sap sterilization systems are currently available for maintaining sap quality in storage. These range from relatively simple and inexpensive to more complex and costly models used to prevent bacterial contamination of liquids such as apple cider.

Under any circumstances, sap should be processed into syrup as soon as possible after collection, particularly when temperatures are above freezing.

End-of-season tank cleaning should be completed as soon as possible after sap collection ends, using either hot water or bleach/water solutions followed by triple rinsing.



SYRUP PRODUCTION

Sap Processing

Unless outside temperatures are below freezing or sap is refrigerated, storing sap for more than 12 hours will result in lower quality syrup. Whenever possible, all sap on hand should be processed into syrup before shutting down the evaporator.

Reverse Osmosis (RO)

RO machines that once required entire large rooms to house, have become much smaller and less expensive over time, resulting in their use by more and more producers. The primary advantage to the use of RO is to enable mechanical removal of 50 to 75% of the water in sap prior to evaporation.

Producers should refer to manufacturers' technical guidance on proper installation, use, cleaning and storage of RO machines. In general, the useful life of RO membranes will be extended and sap processing efficiency improved if sap is kept cool and filtered well prior to entering the RO. Also important is collection of "permeate" (the filtered water extracted from the sap) to use in cleaning the RO after each day's run.

Likewise, thorough cleaning of the RO system at the end of the season, typically using an alkaline cleanser and adequate rinsing, is the standard operating recommendation. Follow use of any cleaning solution or anti-bacterial membrane storage solution by a complete rinse with clean, potable water before processing any sap the following season.

Evaporators

Many different brands and styles of maple evaporators are in use today. Unlike older models, most evaporators produced within the past 10-15 years have welded, rather than soldered pans, and are made from stainless steel rather than a variety of materials previously used. As is the case with buckets and tanks, older (pre-1995) galvanized or terneplate evaporator pans or those with bronze or brass fittings, have a high lead content and should be phased out of maple syrup production.

Producers that are still using lead-containing equipment should minimize the time sap and syrup remain in contact with the equipment. Use

of acidic pan cleaners is not advised because they can remove surface deposits of sugar sand over lead-containing seams/surfaces and result in greater contact of lead-containing materials with sap/syrup. Until lead-containing equipment is eliminated, periodic testing of syrup for lead content is advised at the beginning, middle and end of the season.

Evaporator Cleaning, In-Season

Evaporator pans should be kept as clean as possible of accumulated mineral deposits (niter or sugar sand) during the production season. Niter buildup on the inside bottom of evaporator pans can slow evaporation rate by reducing heat transfer. It can also cause pans to scorch resulting in a burned flavor and a lower syrup grade. Niter accumulation can be reduced by frequently changing draw-off sides or swapping and cleaning pans when using cross-flow pan designs.

Periodic removal of thin scale accumulations can be done by filling the pans with a dilute water/vinegar solution, bringing them to a boil, allowing them to cool and sit for 12-24 hours, followed by scrubbing with a stiff nylon brush or non-scratching pad.

Finishing Syrup

A key aspect of maple syrup quality is that it is finished to the legally-required minimum density of 66° BRIX at 68° F. Syrup below this density is likely to ferment in the drum or other container and result in unacceptable consumer quality. Syrup finished at a density of 68° BRIX or greater may crystallize in the container, and also can result in consumer dissatisfaction. Be sure that temperature probes on the syrup pan are calibrated frequently, especially under conditions of rapidly-changing barometric pressure, and that niter accumulation on the stem is periodically removed as both factors can result in drawing off syrup that is not of proper density.

Numerous measuring devices are available to test syrup density, and producers should have one or more on hand to test what is coming out of the evaporator. Hydrometers need to be regularly checked for accuracy, and many producer organizations provide this service to members at annual meetings or other events. Periodically calibrate refractometers against a sugar standard to insure accuracy.

Automatic draw offs, while valuable and commonly-used, should be checked and adjusted frequently on days when boiling to be sure that the device is opening at the proper temperature and syrup density. Check the output of an automatic draw off with a hydrometer or refractometer.

Hydrotherms (special hydrometers with built in thermometers) are not recommended.

Syrup Filtration

Many different techniques are available for filtering finished syrup ranging from relatively inexpensive paper and cloth filters to more expensive canister or plate-type pressure filters. New cloth filters and paper pre-filters should be boiled in water alone (not in sap) and air-dried prior to use. Filters should not be cleaned with bleach, detergent, or other household cleaners to avoid imparting possible off flavors to syrup. Avoid the use of “musty” smelling filters for the same reason.

Many producers combine multiple steps in filtration, for example, by using paper or cloth filters to remove some of the sugar sand followed by a pressure filtration before moving syrup into a storage container. Whether canister or plate type, pressure filters should be thoroughly cleaned with hot water prior to use and between uses, and only food-grade filter-aid (diatomaceous earth) should be used.

Syrup grading

At present, grading of maple syrup is based on clarity and color. Cloudy syrup is often caused by the presence of suspended solids and can result in a downgrading of the syrup. Grading is accomplished by comparing the syrup being produced to one of several types of color comparators. Some of the less expensive comparators can fade over time and should be avoided. All syrup sold in a particular state or province should meet the grading standard in effect in that jurisdiction.

Syrup flavor, while certainly a component of consumer choice when purchasing pure maple syrup, is quite often related to syrup color, given that darker grades tend to have stronger maple flavor. However, no general agreement exists in the maple industry for how to use flavor in the context of a grading standard. Nonetheless, producers are advised to insure that only the highest quality and best flavored syrup is entered into the marketplace. Syrup with off flavors or smells, whether from improper finishing, external contamination (e.g. imparted from gathering/storage tanks, filters, drums or other containers), or simply related to the time of year it was produced (e.g. “buddy” sap) should never be placed into retail containers.

Bulk Packaging and Storage of Syrup

Although producers will sometimes pack a portion of the properly finished and graded crop directly into retail containers during the season, most will usually pack at least a portion into bulk containers for later retail packaging. Storage into bulk containers of various sizes has several advantages, including maintaining higher syrup quality over time.

Stainless drums designed for food use are the preferred storage medium, although plastic or epoxy-lined drums used for other food products

(e.g., honey) also can be used. Old galvanized drums should be avoided. All drums should be examined with a flashlight before use and thoroughly cleaned using steam or potable hot water at a minimum.

Regardless of what sort of bulk container is used, best results are achieved by packing them hot (180° F.) and filling them completely. Sterilize bungs and tighten them securely, replacing gaskets if necessary. Mark each drum with the syrup grade, and the date produced/packed. Store bulk drums under refrigeration if possible or at least in a cool, dry place. Once a bulk drum is opened, it is best if the entire drum is packed at one time, as opening a drum can allow mold and yeast spores to enter and contaminate the cool syrup.

Retail Packaging and Storage of Syrup

Maple producers have their choice of a wide variety of food grade retail container designs, sizes, and materials, including plastic, glass, metal and ceramic. Each has advantages and disadvantages that producers will need to assess in terms of cost, durability, and maintenance of syrup quality, shelf life and suitability for varying marketing channels. Whatever type is used, retail containers should ideally be packed immediately prior to sale so that they have the maximum possible shelf life.

Use only retail containers that are new, undamaged, clean, dry, and free of foreign matter, and pack them hot (i.e., between 190° to 195° F.). Closely follow the manufacturer's recommendations when packaging (e.g., filling to proper level, turning containers on their side to sterilize the caps and inner seals, etc.). After hot packing, cool containers to room temperature as quickly as possible before packing into cases to avoid the decrease in quality known as "stack burn". Stack burn can often result in syrup darkening one or more color grade.

Record keeping

Maintain and keep a packaging record that codes each container packed from a single lot of syrup so that all syrup from that lot can be identified should a problem develop and a recall be needed. Mark and keep a sample of each lot packed as a record of the syrup characteristics when first placed into retail containers. Ideally, syrup should only be packed into retail containers immediately prior to sale, although this is often not practical. If being held prior to sale, store containers in a refrigerator or freezer or in a cool, dark room with minimal temperature fluctuations and controlled humidity.

When containers are sold to a wholesale customer (e.g., farm stand, supermarket, etc.) they should be marked with a "packed on" date to allow the customer to easily determine if they have exceeded the recommended shelf life. Maintain wholesale distribution records for a period of time greater than the anticipated product shelf life.



SUGARHOUSE CLEANLINESS

Daily Sugarhouse Cleaning and Sanitation

A thorough cleaning of the sugarhouse at the end of each boiling day will help to deter pests and reduce the potential for syrup contamination. All working surfaces should be cleaned with hot water, rinsed and then sanitized with a mild bleach and water solution.

Rinse and hand scrub all holding tanks after they are emptied of sap. If microbial growth is evident (surfaces are “slimy”) sanitize and thoroughly rinse before allowing fresh sap to enter. Water wash and air dry all cloth or paper filters: do not use sanitizers. Clean the RO machine according to the manufacturer’s recommendation. Flush water through the pre-heater.

Mechanically clean syrup pans to the extent needed to avoid sugar sand buildup that can cause a decline in syrup quality. Use stiff brushes or Teflon pads to remove thin layers of scale. Fill syrup pans with water, soak and boil prior to scrubbing to remove heavier accumulations. Avoid using acid cleaners, especially on pans constructed with lead solder. Keep a daily cleaning record.

End-of-Season Sugarhouse Cleaning, Sanitation and Upgrades

Clean RO machines, evaporators, storage tanks, countertops, floors, filters and all other sugarhouse equipment as soon as possible after the end of the production season. Use plenty of clean, hot water and consider sanitizing appropriate equipment with one part unscented household bleach in 20 parts of water. Always rinse thoroughly after bleach sanitizing.

Try to make one or more improvements to the sugarhouse each year by such things as upgrading to stainless steel and food grade equipment, improving or adding hand-washing facilities, improving lighting, eliminating potential safety hazards, etc.

Store all equipment in an area where it will remain dry and free of dust, cobwebs and other foreign matter. Store paper or cloth filters in tightly-closed containers to deter rodents or other pests. Before using next season, rinse all equipment with clean water prior to use.

Evaporator Cleaning, End-of-Season

Some producers clean the evaporator using fermented sap. As sap is allowed to stand in the pan for 3-4 weeks, it undergoes dramatic changes, becoming “ropy” and increasingly more acidic. These accumulated acids work to loosen the scale. Filling the pans with water and heating them to boiling is the normal procedure before they are used the next season.

Removal of significant scale accumulations either during or after the season may require use of chemical cleaners (e.g., phosphoric acid) specifically labeled for use with maple equipment. When using chemical cleaners, always secure a copy of the label and follow the directions provided therein and with the Material Safety Data Sheet (MSDS) for that material.

Acid-based cleaners should be thoroughly rinsed off all pan surfaces and a baking soda solution used as the first rinse to neutralize the acid.

Care should be taken to also clean accumulated carbon off the undersides of pans, particularly the flue pan, as the buildup can reduce boiling efficiency and sometimes result in corrosion and leaks.

Pest Management in the Sugarhouse

Ants and rodents are the most common pests in sugarhouses, although birds and raccoons can sometimes also cause problems. Household pets can potentially contaminate syrup with shed hair as well.

Ants (both small and large) can cause contamination of syrup by their presence in sap tubing, storage/filter tanks, drums and retail containers. Although it is extremely difficult to completely close off sugarhouses to ants, proper cleanliness can make them less attractive. Always keep drums or other containers tightly closed and always wash down any surfaces that might contain syrup residue (e.g., counters, packaging systems, candy-making equipment, etc.). Avoid surface sprays of contact pesticides in favor of boric acid ant baits.

For both small and large mammals, fecal material (droppings) and hair/feathers are the primary potential contaminants, although nesting materials and stored winter food should also be eliminated from the sugarhouse. Keep all doors and windows in good operating order and tightly closed. Install door sweeps under all doors to prevent rodent entry. Seal all cracks and crevices around wires pipes and vents to deter pest movement into and within the building.

Although mouse or rat poisons should not be used inside the sugarhouse because of the risk of contaminating syrup, they can legally be used outside the sugarhouse in clearly marked bait stations. Bait stations should be tamper-resistant, and attached to some solid object to protect humans and pets from potential injury or death.

A variety of traps can be used to monitor presence of and eliminate mice or rats without use of poisons. Snap traps or live traps baited with peanut butter are particularly effective if placed along walls or in hidden areas where rodents travel and hide. Glue traps can also be used, but these are somewhat less effective and, like live traps, require one to deal with live rodents.

Frequently empty all interior trash containers and do not allow other sources of food to remain outside of rodent-proof containers. Locate

dumpsters and other trash containers as far as possible from the building and see that they are emptied regularly.

SUGARHOUSE PREPARATION CHECKLIST
Source: Ontario Maple Syrup Operations Manual

Checked By:_____ **Date:**_____

	YES	NO	NA	Corrective Actions
Sugarhouse Exterior				
Openings covered				
Doors and windows tight				
Perimeter free from debris				
Sugarhouse Interior				
Walls clean				
Overhead areas clean				
Floor clean				
Interior free from clutter				
Equipment				
Sap filters cleaned and dried				
Reverse osmosis machine clean				
Pre-heater clean				
Rear pan clean				
Front pan clean				
Gravity syrup filters clean				
Pressure filters replaced				
Finishing pan clean				
Filler clean				
Pest Management				
Garbage pails have lids				
Supplies properly stored				
Exterior openings sealed				
Pest traps available				
Bait traps in place				

Daily Equipment Cleaning Checklist
Source: Ontario Maple Syrup Operations Manual

Checked By: _____ **Date:** _____

	YES	NO	NA	Corrective Actions
Equipment Sanitation				
Sap collection tanks/buckets washed				
Pump #1 cleaned				
#2 cleaned				
#3 cleaned				
Sap tanks – tank #1 washed				
– tank #2 washed				
Sap filters – filters washed				
– clean filter installed				
R.O. machine – membrane clean				
– back flushed				
Preheater flushed				
Sap pan – sap drained				
– pan cleaned mechanically				
– pan cleaned with chemicals				
Syrup filters – gravity filters washed				
– clean gravity filter installed				
– pressure filters replaced				
Finish pan – washed				
Filler – washed				
Measuring devices – cleaned				
Work surfaces – cleaned				

Comments:

Daily Building Cleaning Checklist
Source: *Ontario Maple Syrup Operations Manual*

Checked By: _____ **Date:** _____

	YES	NO	NA	Corrective Actions
Building Sanitation				
Floors cleaned				
Supplies put away				
Chemicals stored in separate area				
Chemicals clearly identified				
Unnecessary clutter removed				
Washroom cleaned				
All drains functioning properly				
Pest Control				
Garbage pails emptied				
Garbage pails have lids				
Pest control devices serviced				

Comments:

Source: Ontario Maple Syrup Operations Manual

Checked By: _____ **Date:** _____

Bacterial					
Testing Lab	Date Sampled	Sampled by	Total Coliform	E. coli	Action Taken
Additional Tests					
Testing Lab	Date Sampled		Results		Action Taken
Comments:					

Acknowledgements

In addition to the lead author's 35 years as a commercial maple syrup producer, this manual was developed with frequent reference to and citation from several key information sources: The Ohio State University Extension publication *North American Maple Syrup Producers Manual, Second Edition; Design, Installation and Maintenance of Plastic Tubing Systems for Sap Collection in Sugar Bushes*; the Ontario Ministry of Agriculture, Food and Rural Affairs publication *Food Safety Practices for the Production of Maple Syrup*, the University of Maine, Orono, Cooperative Extension Bulletin # 307 *Maple Syrup Quality Control Manual*, and the *Maple Syrup Quality Control Manual* published by the Massachusetts Maple Producers Association. We thank and credit the authors of these documents for much of the content herein.

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RESOURCE INFORMATION

- *North American Maple Syrup Producers Manual, Second Edition*. Ohio State University Extension \$17.50 @ <http://estore.osu-extension.org/productdetails.cfm?sku=856>
- *Design, Installation and Maintenance of Plastic Tubing Systems for Sap Collection in Sugar Bushes*. Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)
<http://www.omafra.gov.on.ca/english/crops/hort/agrofore.html#maple>
- *Food Safety Practices for the Production of Maple Syrup*. Ontario Ministry of Agriculture and Food (OMAFRA)
<http://www.omafra.gov.on.ca/english/crops/hort/agrofore.html#maple>

MAPLE BMP CHECK LIST

GENERAL OPERATIONS

SUGARBUSH SELECTION AND MANAGEMENT

Site Selection and General Management

- ☐ The sugarbush consists of a stand of healthy, mixed age sugar maple trees perhaps with some red maple mixed in) growing on a well-drained but not droughty site with good soils
- ☐ Trees have large, well-developed crowns
- ☐ Damaged, diseased or insect-infested trees and those of lower quality are periodically removed
- ☐ Access roads are sited to reduce root damage or sap contamination from mud or dust when buckets are used
- ☐ Livestock pasturage is kept at a level that does not damage trees or eliminate regenerative maple growth
- ☐ Synthetic fertilizers and/or pesticides are rarely if ever applied and then only under supervision of a properly-licensed applicator

Safety In The Sugaring Operation

- ☐ Producers periodically inventory the sugaring operation it identify sources of risk, develop a safety plan to reduce risk and train staff in safe operational procedures.
- ☐ Working in the woods is avoided on windy days
- ☐ Proper chainsaw safety procedures are followed and PPE is always used
- ☐ Power tappers are adjusted to idle properly
- ☐ Appropriate footwear and clothing is worn to match environmental conditions
- ☐ The buddy system is always used when working in the woods, especially at remote sites

Sugarhouse Design and Construction

- ☐ The sugarhouse is capable of excluding birds, rodents and other pests
- ☐ Interior surfaces are impermeable materials that can be cleaned
- ☐ A potable water source is available and tested for quality at least once annually
- ☐ A hand washing station is available for workers and/or guests
- ☐ All equipment is designed for use in maple sugaring and can be periodically cleaned and sanitized as needed

- ❑ All equipment is stainless steel and lead free
- ❑ Pesticides and other toxic chemicals are not stored or used in the sugarhouse
- ❑ Only food grade lubricants are used for any sap/syrup handling equipment

Sugarhouse Water

- ❑ The sugarhouse has a source of clean potable water
- ❑ The sugarhouse water source is tested at least once a year of coliform bacteria and E. Coli
- ❑ The sugarhouse has a source of hot water
- ❑ A properly-installed sink with hot and cold faucets is available for hand and equipment washing

Sugarhouse Safety

- ❑ All sugarhouse electrical service and equipment are properly installed and grounded
- ❑ All circuits are GFI protected whenever moisture is likely to be present
- ❑ Sugarhouse workers are alerted to the many hot surfaces present
- ❑ Long sleeved shirts and firing gloves are used when firing with wood
- ❑ One or more 10 pound ABC type dry chemical fire extinguisher is available in the sugarhouse

Pre Season Sugarhouse Preparation

- ❑ All surfaces and equipment is washed with clean potable water
- ❑ The RO machine is cleaned and rinsed according to manufacturer's recommendations
- ❑ If present, the pre-heater is flushed with water before use
- ❑ The evaporator is filled with water, boiled for an hour and thoroughly rinsed.
- ❑ Sap filters are washed and air dried

SAP COLLECTION AND STORAGE

Tapping

- ❑ Only thawed or partially thawed trees are tapped
- ❑ New tap holes are drilled 5 inches away from either side and 6 inches above and below old tap holes.
- ❑ Sharp, sanitized bits are used
- ❑ An effort is made to avoid contaminating newly-drilled tap holes

- Bleach, alcohol, iodine or paraformaldehyde are never used to sanitize tap hoses

Spouts

- Smaller spout types are used to reduce overall tree damage
- Sanitized spouts/spout adapters are used
- Producer field-tests backflow preventing spouts
- Spouts are seated gently

Tapping Guidelines

- Trees smaller than 10-12" DBH are not tapped
- Trees greater than 36" DBH receive no more than 4 taps

Sap Collection Systems

- Galvanized buckets are replaced with aluminum ones or plastic sap bags
- Terneplate buckets or those with thin galvanized coating are eliminated
- Non-food grade plastic containers (e.g. drywall buckets, paint buckets, stock tanks) are not used
- Containers that formerly held hazardous materials or that can rust are never used
- If buckets are used, they are emptied at least every few hours, especially under warm conditions
- A properly laid out, vacuum-assisted tubing system is employed wherever possible
- Buckets and tubing systems are cleaned each year as soon as possible after the end of sap flow

Sap Storage

- Non-food grade containers are not used to collect or store sap
- Sap is filtered frequently through filters that are cleaned and sanitized frequently during the season
- UV sterilization is used to reduce microbial contamination of sap, especially when tubing systems are used for collection
- Storage tanks are cleaned frequently with hot water, sanitized and triple-rinsed between runs
- Sap should be refrigerated or otherwise kept as cold as possible
- Tanks are cleaned, sanitized and triple-rinsed as soon as possible after sap flow ends

SYRUP PRODUCTION, STORAGE AND PACKAGING

Reverse Osmosis

- When feasible, an appropriately-sized RO machine is used to reduce fuel cost and boiling time
- The RO is rinsed with permeate water after each day's use
- The RO is cleaned at the end of the season using a recommended alkaline cleaner followed by rinsing
- RO membranes are periodically returned to the manufacturer for additional cleaning

Evaporators

- Syrup evaporators made from materials other than lead free stainless steel are phased out
- Producers still using lead-containing equipment minimize sap and syrup contact time, and minimize use of acid pan cleaners
- Evaporator pans are kept as free as possible of sugar sand accumulation during the season

Syrup Finishing, Filtering and Grading

- Syrup is finished to the required density of between 66 and 68 degrees BRIX and tested using a properly calibrated hydrometer, hydrotherm or refractometer
- Syrup is filtered with paper and cloth gravity filtration at minimum
- Syrup is filtered with a pressure filter using food grade diatomaceous earth
- Filters are cleaned and rinsed properly
- Syrup is graded accurately by comparing it to a quality color comparator
- Syrup with off flavors or smells is never put into retail containers

Bulk Packaging and Storage of Syrup

- Syrup is stored into steam clean, stainless steel or lined food-grade drums
- Old galvanized drums are eliminated from the production system
- Bulk containers are packed hot, with a minimum amount of airspace and sealed tightly with sterilized bungs
- Bulk containers are marked with the syrup grade and the date produced/packed
- Bulk containers are refrigerated or at least stored in a cool dry place

- Once a bulk container is opened the entire container is packed into retail containers rather than re-sealed.

Retail Packaging and Storage of Syrup

- Only new, undamaged, clean and dry containers are used
- Retail containers are packed hot (190° F)
- Containers are packed to the proper level and turned on their side to sterilize caps and inner seals
- Containers are cooled to room temperature before packing into cases to avoid "stack burn"
- Each container packed from a single lot of syrup is coded
- A sample of each packed lot is kept and stored properly for future reference
- Retail containers are packed as closely as possible to date of sale
- Retail containers held prior to sale are stored in a cool, dry and dark storage
- Retail containers are marked with a "packed on" date

SUGARHOUSE CLEANLINESS

Daily Sugarhouse Cleaning and Sanitation

- Sugarhouse is cleaned thoroughly at the end of each boiling day
- All working surfaces are cleaned with hot water and sanitized with a mild bleach and water solution
- All holding tanks are rinsed and scrubbed after they are emptied and sanitized if microbial growth is evident
- All cloth/paper filters are washed and air dried
- No sanitizers are used on filter cloths/papers
- The RO machine is washed according to manufacturer's recommendations daily
- Water is flushed through the pre-heater
- Syrup pans are filled with water, boiled and scrubbed with a stiff brush or Teflon pad to remove scale
- Sap flow is reversed or cross-flow pans moved to deter scale formation
- Acid cleaners are not used to remove scale, especially on pans constructed with lead solder
- A daily sugarhouse cleaning record is kept

Evaporator Cleaning, End-of-Season

- Evaporator is thoroughly cleaned using either fermented sap or acid cleaners
- If used, acid cleaners are neutralized and thoroughly rinsed off evaporator surfaces
- Accumulated carbon is removed from the undersides of syrup and flue pans

Pest Management in the Sugarhouse

- The sugarhouse is kept as tight as possible to deter pest entry
- The sugarhouse is kept as clean as possible to deny pests access to food (i.e., syrup, food stuffs, trash)
- Drums and other containers are always kept tightly closed
- Rodent poisons are never used inside the sugarhouse
- Secured, tamper-resistant bait stations are deployed against rodents along the building exterior perimeter
- Traps are deployed inside the sugarhouse in areas traveled by or otherwise used by rodents.
- All trash containers are emptied frequently
- Dumpsters are positioned at a distance from the sugarhouse and emptied frequently.